Improved Pore Space Utilisation
Australia & United Kingdom Co-lead

• Purpose is to:
  • Discuss concept of improved utilisation of geological storage space resource to increase CO₂ storage capacity.
  • Review the current state of processes and technologies that enhance the utilisation of the storage space
  • Highlight key techniques recently emerged internationally
  • Provide a (possibly ranked) set of options for stakeholders to develop into their storage projects.

• Members/Input from:
  Australia, United Kingdom,
  IEAGHG, France, Japan, Norway,
  United Arab Emirates

X-ray CT images of Brine-Saturated Cores:
Right: Microbubble CO₂ Injection
Left: Normal-size Bubble CO₂ Injection
CSLF TRM recommended storage rate for 2035
>2.4 Gigaton
Storage Utilisation

Economies of scale
• Cost to characterise
• Cost to transport
• Cost to operate
• Cost to monitor

Bickle, 2009
Fundamental to Improved Pore Space Utilisation

IPCC special report 2005
Improved Pore Space Utilisation Techniques

• Improved Sweep Efficiency techniques from the oil and gas sector
  • Polymers
  • Surfactants
  • Foams
• Pressure Management
  • Relief wells (active and passive)
  • Increased Injection Pressure
• Microbubble CO₂ Injection (Japan)
• CO₂ Saturated Water Injection and geothermal energy (France)
• Compositional, Temperature and Pressure Swing Injection (Norway)
<table>
<thead>
<tr>
<th>P</th>
<th>Technology Type</th>
<th>Prior R&amp;D and application</th>
<th>Technology Readiness Level#</th>
<th>Technology Prospectively</th>
<th>Core Recommended Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Microbubble CO₂ Injection</td>
<td>Laboratory and Modelled, prototype</td>
<td>TRL 4</td>
<td>High potential</td>
<td>Trial at in field research facility</td>
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<tr>
<td>2</td>
<td>Swing Injection</td>
<td>Laboratory and Modelled</td>
<td>TRL 3</td>
<td>High potential</td>
<td>Validate technology at lab scale</td>
</tr>
<tr>
<td>3</td>
<td>Increased Injection Pressure</td>
<td>Laboratory and Modelled</td>
<td>TRL 3</td>
<td>High potential</td>
<td>Validate technology at lab scale to assess sweep effectiveness in heterogeneous reservoirs</td>
</tr>
<tr>
<td>4</td>
<td>Active Pressure Relief (increase sweep &amp; reduce lateral spread)</td>
<td>EOR, planned for Gorgon CO₂ injection project</td>
<td>TRL 6</td>
<td>High potential</td>
<td>Pressure relief - Key lessons drawn from active commercial project using pressure relief wells as a risk mitigation technique</td>
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<td>5</td>
<td>Foams (block high permeability pathways)</td>
<td>EOR</td>
<td>TRL 6</td>
<td>Reasonably well understood</td>
<td>Modelling of application effectiveness prior to Demonstration at commercial scale</td>
</tr>
<tr>
<td>6</td>
<td>Passive Pressure Relief</td>
<td>Modelled</td>
<td>TRL 4</td>
<td>Limited effectiveness</td>
<td>Trial at in field research facility. Consideration around long-term fluid management</td>
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<tr>
<td>7</td>
<td>Polymers (increase formation water viscosity)</td>
<td>EOR</td>
<td>TRL 7</td>
<td>Reasonably well understood</td>
<td>Cost effectiveness investigations. Demonstration at commercial scale*</td>
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<tr>
<td>8</td>
<td>Surfactants (reduce residual saturation of formation water)</td>
<td>EOR</td>
<td>TRL 7</td>
<td>Reasonably well understood</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>CO₂ saturated water injection &amp; geothermal energy</td>
<td>Laboratory and Modelled</td>
<td>TRL 3</td>
<td>Site specific &amp; lower volume</td>
<td>Seek opportunity to trial PI-CO₂ technology at lab scale</td>
</tr>
</tbody>
</table>
Improved Pore Space Utilisation Report Release

• Alignment with key contributors
  • 9th November 2018

• Task Force Members to circulate wider within their countries/organisations
  • 30th November 2018

• Report publication and circulation
  • 1st February 2019